LAPAROSCOPIC MANAGEMENT OF UNDESCENDED IMPALPABLE TESTIS

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CERTIFICATE

This is to certify that this dissertation titled 'Laparoscopic management of undescended impalpable testis' is a bonafide work of Dr.CHITHRA RAMU, submitted for the qualifying examination in M.Ch., Paediatric Surgery, Branch-V, to be held in August 2007 by the Dr. M.G.R. Medical University.

Signature of the H.O.D

Signature of the Dean.

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This study would not have seen the light of the day, had not our patients shown the kind co-operation they extended. I sincerely thank them.

LAPAROSCOPIC MANAGEMENT OF UNDESCENDED IMPALPABLE TESTIS – OUR EXPERIENCE

INTRODUCTION

Today we live in the era of minimally invasive surgery. The applicability, advantages and safety of laparoscopy in the field of pediatric surgery have been adequately enumerated and documented.

About 10-30% of undescended testes are impalpable. Of all the available diagnostic modalities laparoscopy offers the most definitive direct visual diagnosis. In fact it is considered a diagnostic gold standard. The diagnostic detail offered is complete and provides adequate information for planning further management in the same sitting either as a single procedure or in a staged manner. In effect laparoscopy appears to be the most ideal diagnostic and therapeutic tool for the management of impalpable undescended testis in a pediatric surgeon's armamentarium.

This study is undertaken to evaluate the role of laparoscopy in management of impalpable undescended testis and to analyse the experience at our institute.

We aim to evaluate the diagnostic fallacies if any, finer technical nuances of the procedure, and to assess the outcome in the

short term, including the incidence and significance of post-operative complications.

AIMS OF THE STUDY

1. To study the relative incidence of impapability of undescended testis.
2. To laparoscopically document the findings of impalpable undescended testis
3. To describe and evaluate laparoscopic surgical technical options in the treatment of impalpable undescended testis.
4. To assess short-term post-operative outcome.

MATERIALS AND METHODS

Study design: This is a retrospective and prospective study analyzing the laparoscopic management - both diagnostic and therapeutic – of the undescended impalpable testis performed at Coimbatore Medical College Hospital, Coimbatore.

Study period: May 2000 to April 2008

Study center: Department Of Pediatric Surgery

Coimbatore Medical College Hospital

Coimbatore

Study group: A total of seventy-six male children with undescended impalpable testis had presented and were managed laparoscopically at our institute during the period of study

Exclusion criteria: All patients with impalpable undescended testis with abnormal serum studies – serum electrolytes, testosterone and dihyhrotestosterone - suggestive of intersex disorders

Age group – 9 months to 13 years

Type of procedures

Diagnostic laparoscopy

Single stage orchiopexy

Staged Fowler-Stephen procedure

Laparoscopic mobilization and open orchiopexy

Atrophic testis excision

EVALUATION

The primary mode of evaluation was the physical examination. Ensuring that the child was comfortable examination was done with the child lying supine with the legs in the frog position and also in the squatting position. The status of the external genitalia was noted to look for signs suggestive of intersex disorders. The rugosity and size of the scrotum was noted and both hemi-scrota compared. A thorough search was made for the testis in the scrotum, the groin, as well as the ectopic sites. If the testis was not palpated, an attempt was made to palpate the cord structures at the level of the pubic tubercle, and a diligent search made for the nodule like atrophic testis. Contra-lateral testicular size was documented, keeping in mind its value as a clinical indicator of possible ipsilateral testicular atrophy

We did not rely on preoperative diagnostic imaging in the form of diagnostic ultrasonogram as it was extremely operator dependant and not always available.

OPERATIVE TECHNIQUE

Anaesthetic considerations

Several important points require discussion between the surgeon and the anaesthesiologist preoperatively, including

a) proper positioning of the patient

b) placement of all monitoring devices

c) the choice of anaesthesia

d) appropriate intravenous access

We prefer general anaesthesia with endotracheal tube in situ. It is preferable to avoid nitrous oxide as it can cause bowel distention and hinder vision and surgical working space

Generally the patient is asked to void urine prior to the onset of surgery. In a very young child the bladder is catheterized at the onset if distended. Alternatively the bladder can be catheterized preoperatively if it is thought to be necessary to aid visualization or dissection. The patient is given a full dose of antibiotics just before induction.

Once the child is under anaesthesia the groin is carefully palpated to look for an inguinal testis that might have been missed.

Set –up

The child is placed in the supine Trendelenburg position and draped in a sterile technique including both the abdomen and the genitalia in operative the field. The surgeon can take one of two positions, i.e., in the younger child he can stand at the head end, and in the older child, on the side of the child towards the head end opposite to the side of the impalpable testis. The former position is especially convenient in the event of bilateral impalpability. The monitor is placed towards the foot end on the side of the impalpable testis.

Port placement

Figure 1 Supraumbilical Port Placement

At our department we generally make a supraumbilical curvilinear cosmetic incision and use the open technique for umbilical trocar introduction, which is a 5mm trocar, and subsequently intraperitoneal location is confirmed visually after introducing a 30^0 5mm scope. The pneumoperitoneum is created using CO_2 at an inflation pressure of 8-12 mm of mercury.

On confirming a safe and uneventful entry into the peritoneal cavity the internal anatomy of the normal groin is first examined to provide a basis for comparison of the abnormal side.

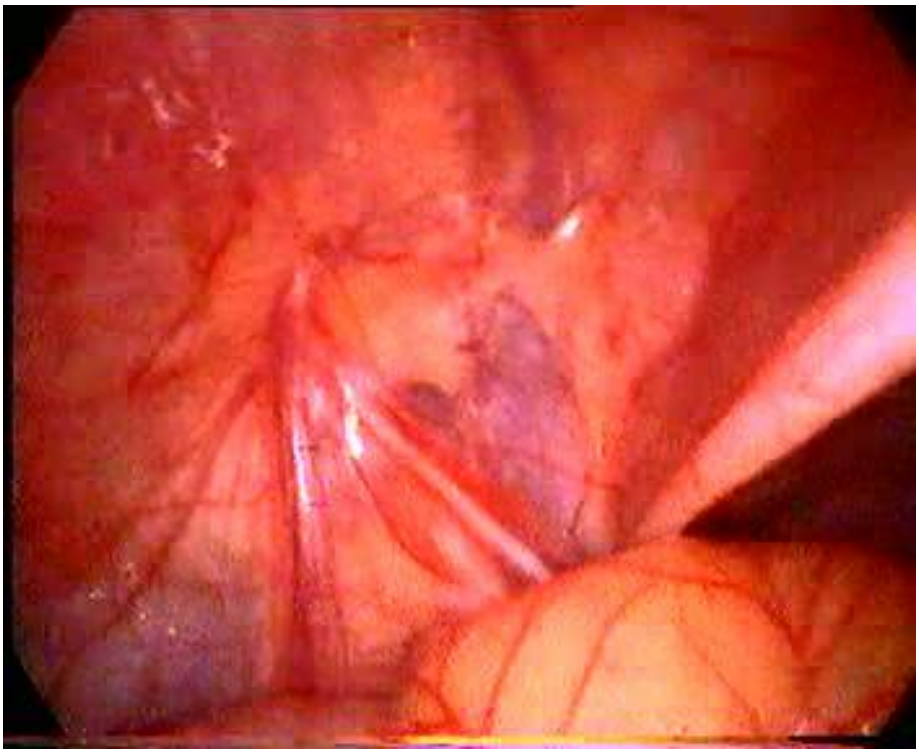


Figure 2 Normal Contra lateral Internal Ring

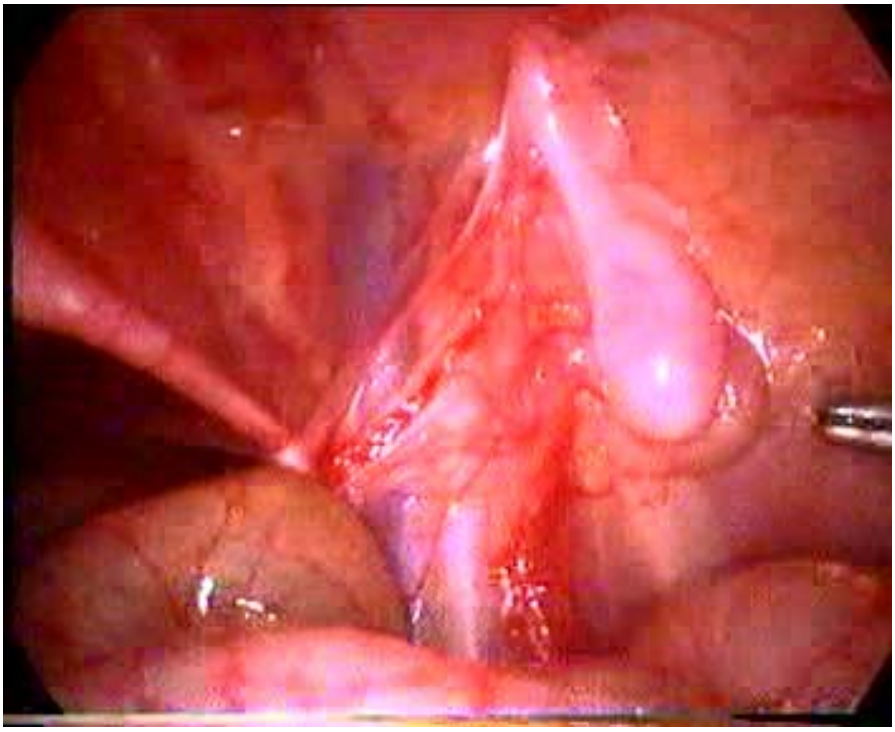


Figure 3 Right Low Intra-abdominal Testis

On the affected side

a) An obvious intra-abdominal testis is first documented if seen noting

- The site of the testis
- The volume of the testis
- The mobility of the testis .
- The distance between the lower pole of the testis and the internal ring
- The status of the internal ring
- The laxity of the vessels

b) If the testis is not seen then the internal ring is described

- Whether it is open or closed
- Whether the vas or vessels are seen entering the ring
- The caliber of such vas and vessels

c) If the testis is not seen and the vas and vessels don't enter the ring, then the testicular artery is traced to its termination to look for the testis which is either along the line of normal descent or ectopic or hypoplastic or vanishing as the case maybe. This maneuver may require the patient position to be changed, the bowel to be moved out of the way or even to be mobilized or the introduction of additional retracting trocars. We have not needed to mobilize the bowel in any of our cases to visualize the testis.

A laparoscopic orchidopexy having been decided upon we then introduce two additional 5 mm working ports under direct vision in the mid clavicular line at the level of the umbilicus.

If the vessel length appeared adequate and, the testis low and mobile, we did a primary single stage laparoscopic orchiopexy without dividing the testicular vessels.

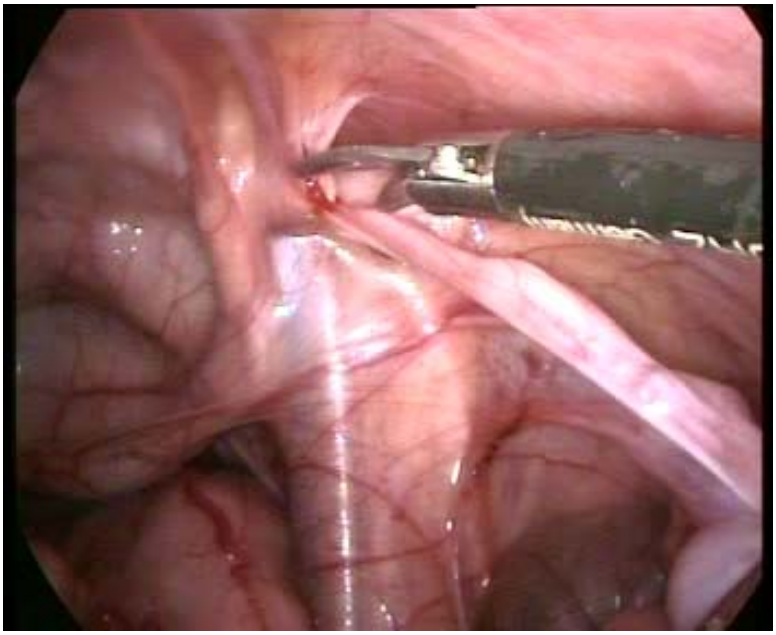


Figure 4 Division of Gubernaculum

Gentle traction is applied on the cord structures beyond the peritoneum to deliver the gubernaculum and it is cauterized and divided as distally as possible to avoid a long looping vas if present.

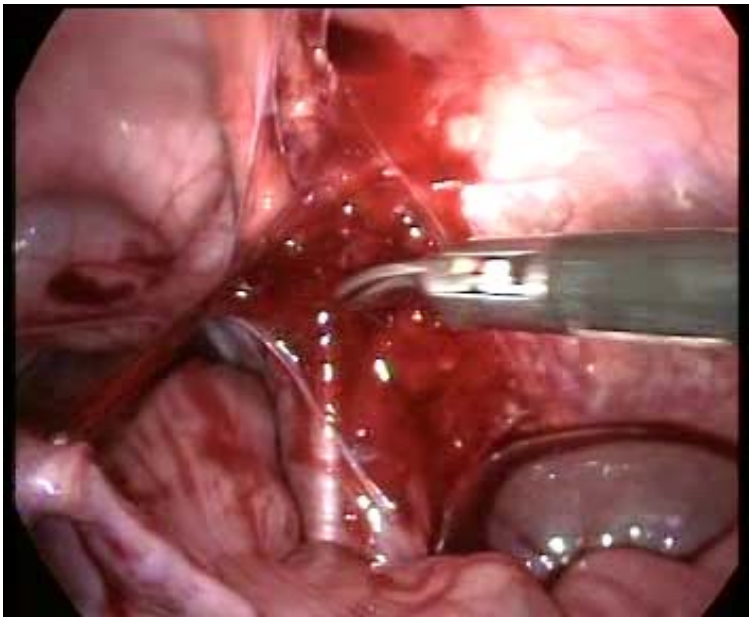


Figure 5 Peritoneal Incision Extending Onto Bladder

Care is taken to incise the peritoneum on to the bladder surface leaving a healthy margin on the medial aspect of the vas and dissection is continued lateral to the vessels preserving a wide undisturbed triangle of peritoneum between the vas and the vessels.

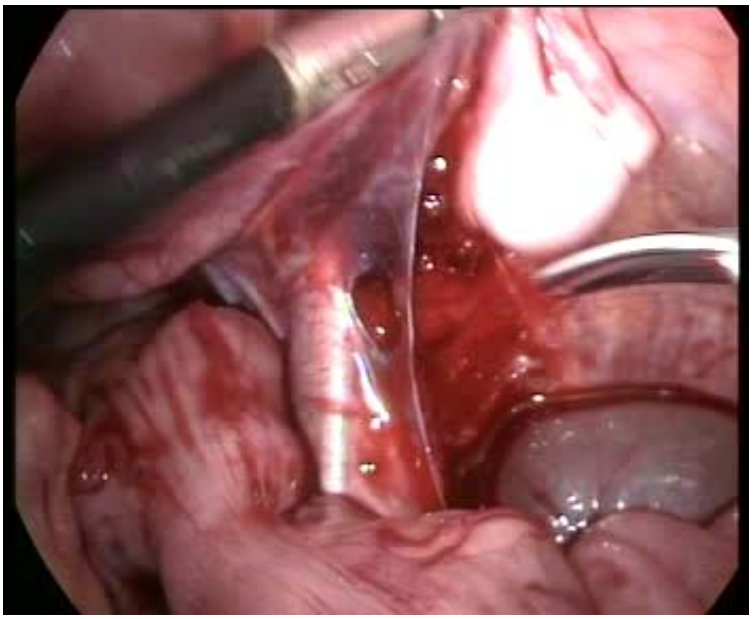


Figure 6 Wide Perioneal Leash Of Vessels

Traction is applied on the gubernaculum towards the contralateral side and the vessels are dissected laterally from the abdominal wall, and the peritoneum over the vessels is divided at the level of the colon.

Once the testis can easily reach the opposite internal ring the dissection is considered complete. This mobilization needs to be generous in older children.

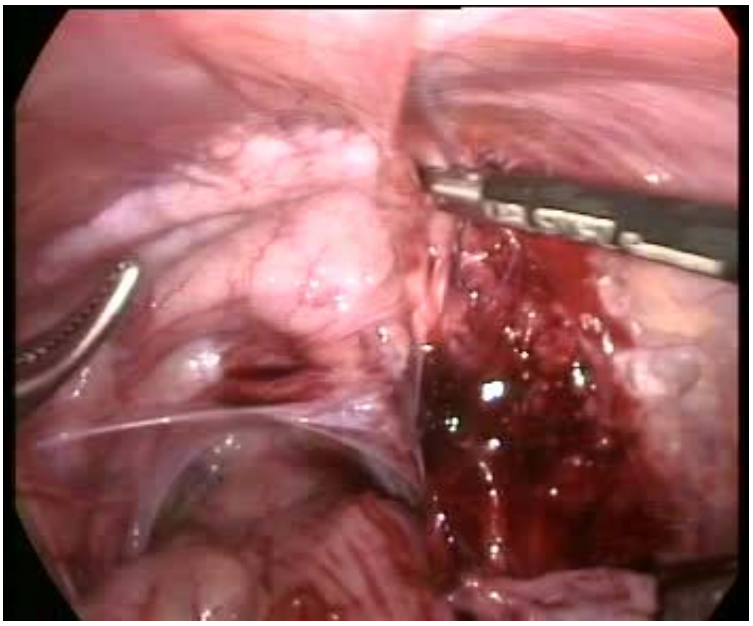


Figure 7 Creation of Neoinguinal Canal

We routinely route the testis medial to the inferior epigastric vessels creating a neo-inguinal canal. A scrotal incision is made and a sub-dartos pouch is created.

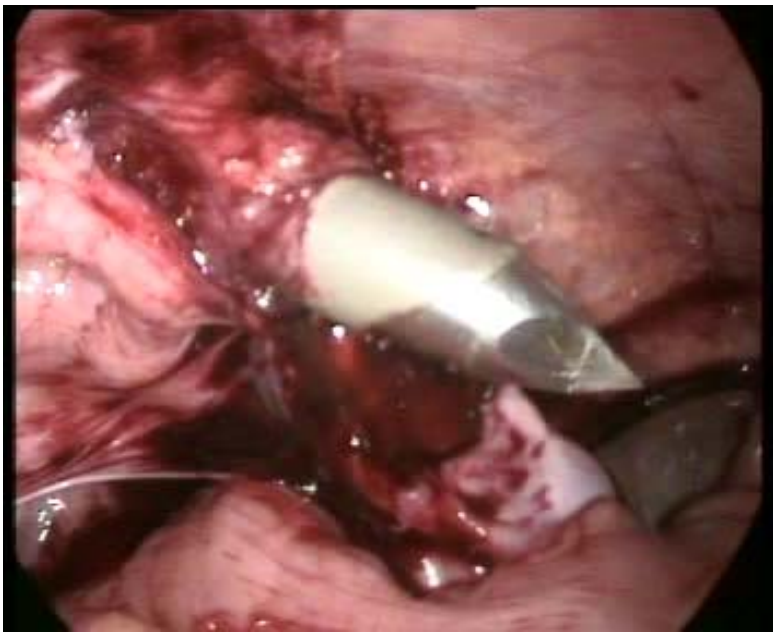


Figure 8 Intrduction of scrotal trocar

A fourth trocar of adequate size to accommodate the testis is introduced through the scrotal wound and guided into the abdominal cavity hugging the pubic tubercle emerging between the bladder and the epigastric vessels utilizing visual laparoscopic guidance. The bladder should be empty at this juncture.

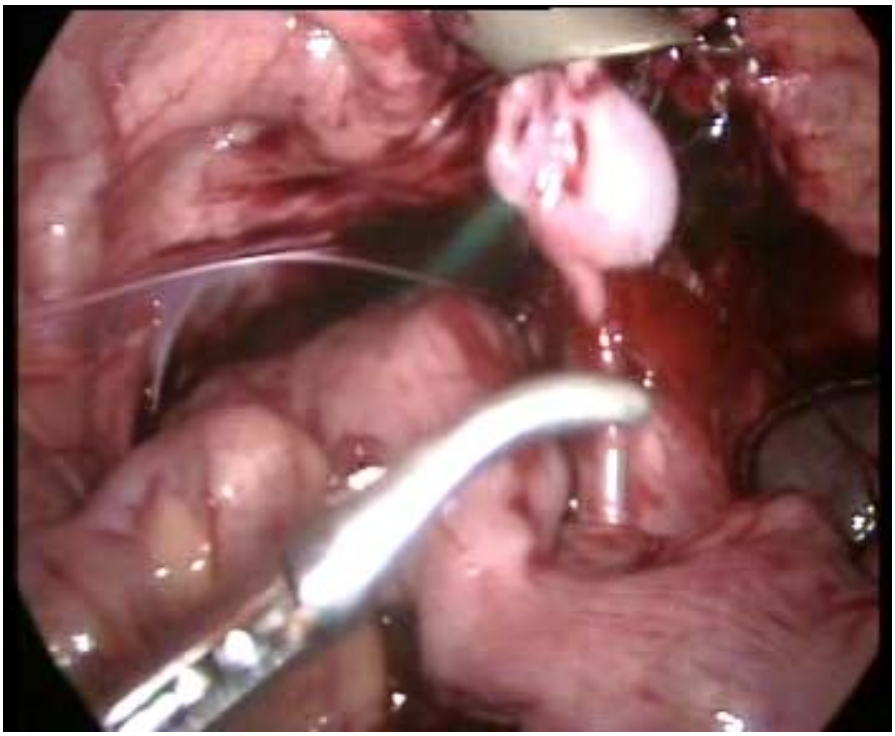


Figure 9 Routing of Testis Through Neo-inguinal Canal

A grasper introduced through the scrotal port holds the gubernaculum and withdraws the testis into the sheath and the instruments are brought out en masse to deliver the testis.

Figure 10 Scrotal Delivery Of Testis

The testis is pexed in the routine manner ensuring that there is no stretch or torsion laparoscopically.

If the vessel length appears inadequate we do not attempt any dissection of the testis, instead we isolate the testicular vessels well away from the testis proximally (high ligation), apply the Fowler-Stephens test to confirm adequate collateral supply and then cauterize the bundle using bipolar forceps and divide sharply.

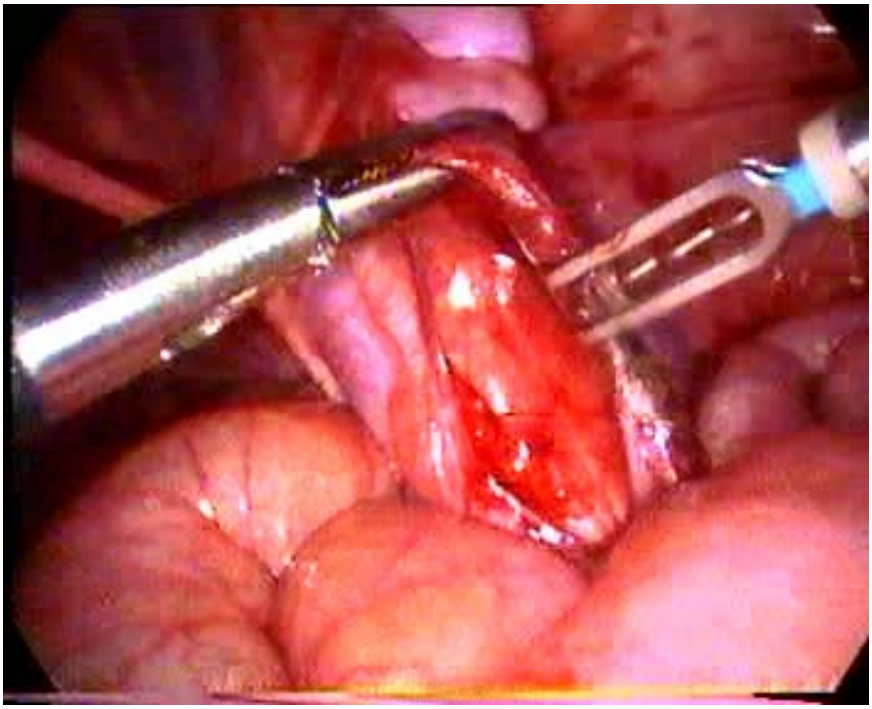


Figure 11 High Cauterisation of the Testicular Vessels

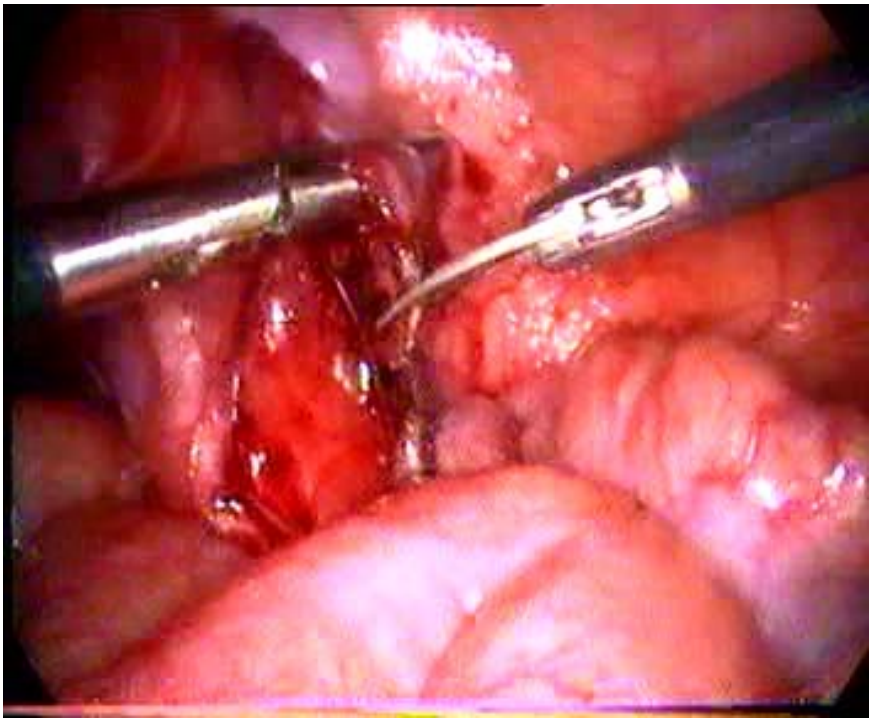


Figure 12 Division of the testicular vessels

After checking for hemostasis the procedure, i.e., 1st stage is completed.

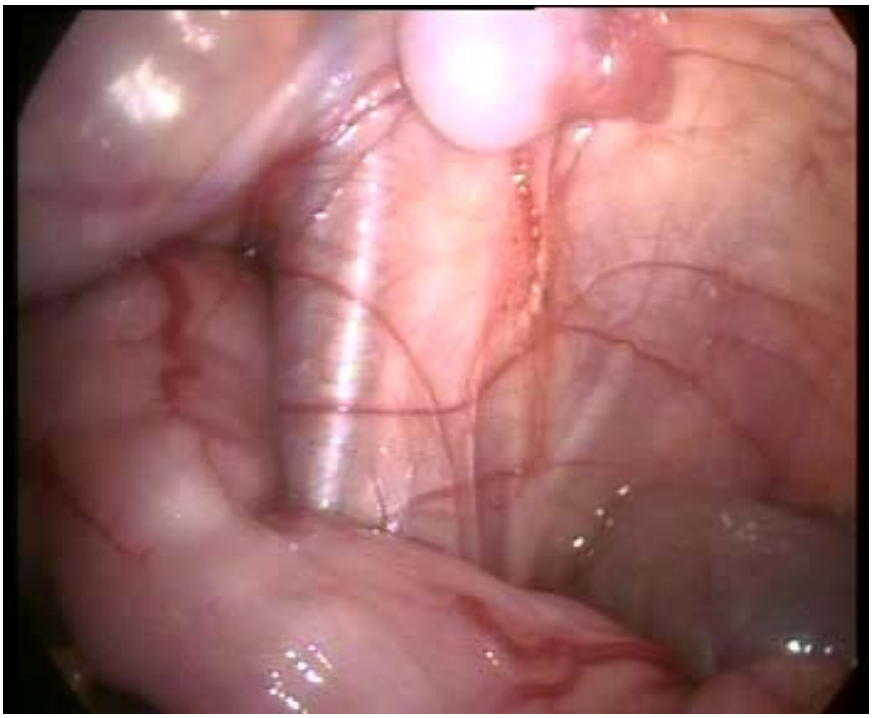


Figure 13 Divided Vessels Seen at IInd Stage

In our department we perform the second stage of the procedure 3-12 months after the second stage. At the second stage the trocars are introduced through the previous trocar sites. We have not noticed any significant intraperitoneal adhesions in any of our cases. The procedure is similar as in the case of a single stage laparoscopic mobilization.

In those cases where the internal anatomy prompted us to do an inguinal exploration, and lead to the identification of an inguinal testis we were able to use the laparoscopic advantages of magnified vision and excellent working space to comfortably dissect the vessels

intra-abdominally to mobilize the testis, thereby limiting the extent of the inguinal dissection.

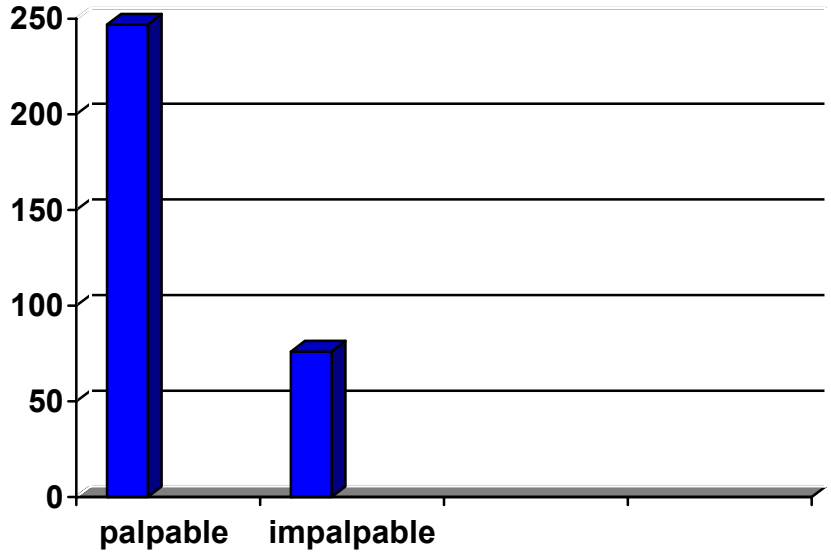
We discharge our patients on the first post-operative day except in the event of complications.

RESULTS

Hospital records, laparoscopy and genitourinary registers maintained at our department between May 2000 and April 2008 were reviewed. Of a total of 345 cases of undescended testes that were managed at our department, two hundred and sixty seven were clinically palpable, whereas seventy-six were nonpalpable.

INCIDENCE

	NO OF PATIENTS	PERCENTAGE
PALPABLE	**247**	**73.84%**
IMPALPABLE	**76**	**22.16%**
TOTAL	**343**	**100%**

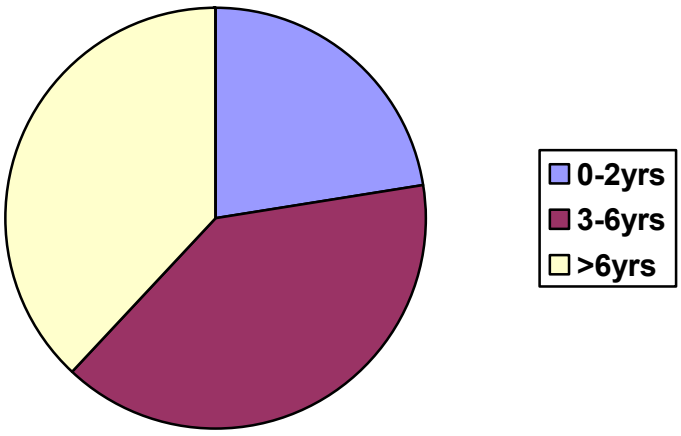


AGE DISTRIBUTION

AGE	NO. OF CASES	PERCENTAGE
≤ 2yrs	17	22%
3 - 6yrs	30	40%
> 6yrs	29	38%

Only one child was brought to the hospital at 9 months of age. In all other patients, though the parents were aware of the condition since birth, they were either unaware of the need for intervention, or were advised to seek pediatric surgical intervention at a later date.

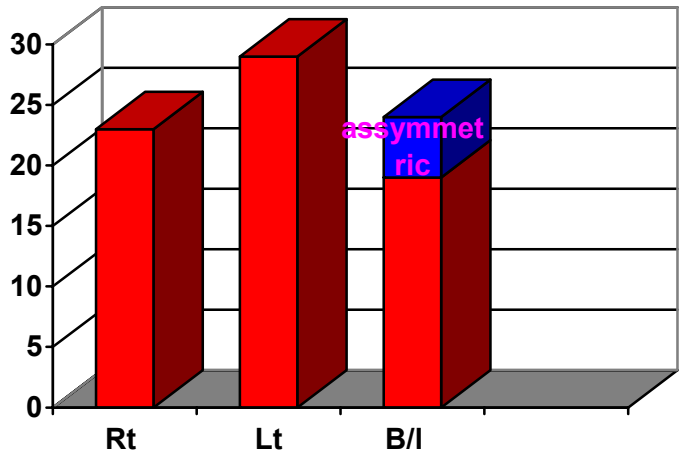
Age distribution



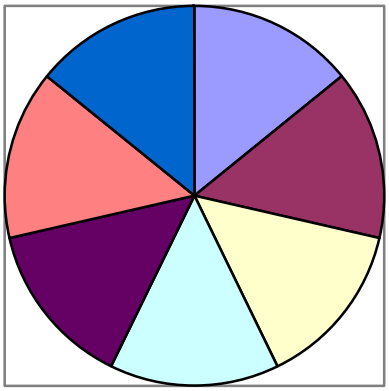
CLINICAL PRESENTATION

PRESENTATION	NO OF PATIENTS	%
ıT IMPALPABLE TESTIS	23	30.25
ı IMPALPABLE TESTIS	29	38.25
ıTERAL SYMMETRIC UDT	19	25
ıTERAL ASSYMMETRIC UDT	5	6.5

There was a fairly equal representation between left, right and bilateral undescended testis. Among the twenty-four cases of bilateral presentation 5 were asymmetric, of which, in 3 cases the right testis was impalpable.



ASSOCIATED FINDINGS



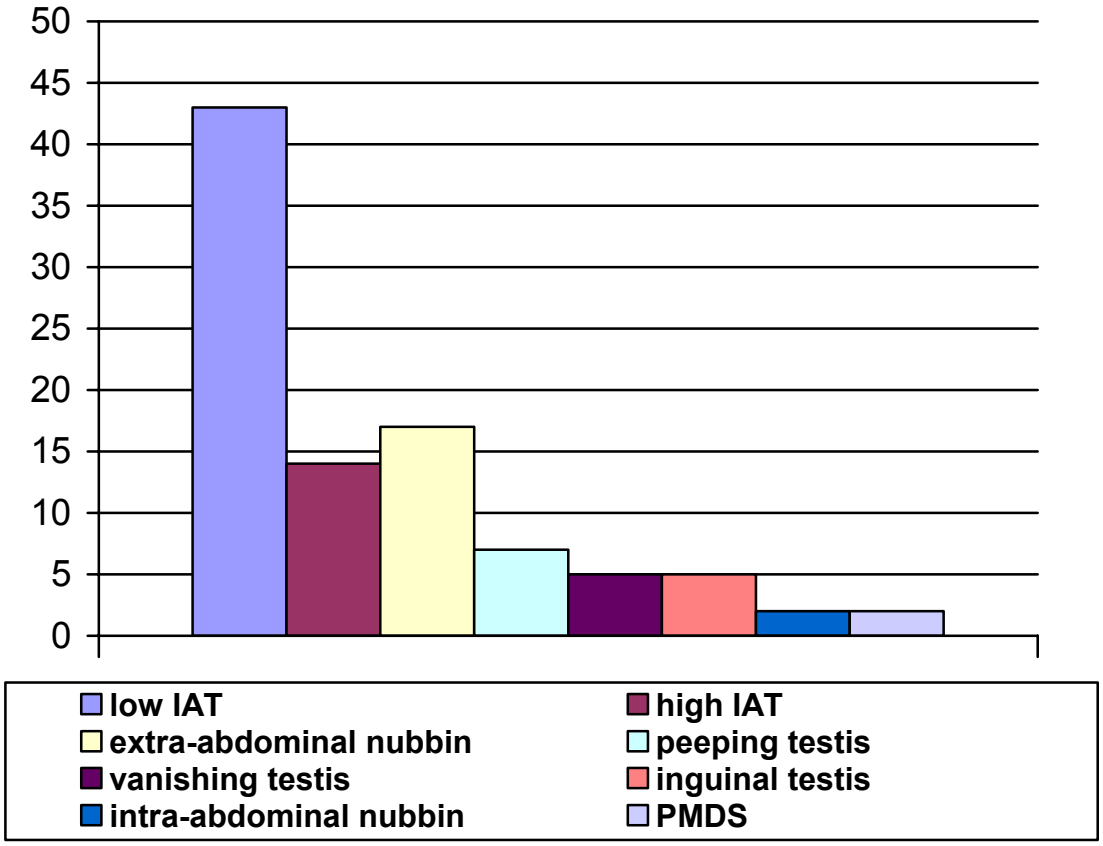
- **prune belly**
- **prune belly with distal hyhospadias**
- **PMDS**
- **panhypoptuitarism ,infantile hemiparesis**
- **b/l congenital cataract**
- **bifid scrotum**
- **mental retardation**

The child with PMDS presented with a right high canalicular testis and left impalpable testis. He underwent diagnostic laparoscopy, on noting the findings of persistent mullerian structures and left intra-abdominal gonad a biopsy was done which confirmed a testis. The child with panhypopituitarism had normal serum parameters and one good volume scrotal testis and a low left intra-abdominal testis with adequate volume on laparoscopy. The child with prune belly and hypospadias underwent urethroplasty six months after orchiopexy. Both children with prune belly did not have any other significant urinary pathology.

TESTICULAR LOCATION AND STATUS

FINDING	NO OF TESTICULAR UNITS	%
LOW INTRA-ABDOMINAL TESTIS	**43**	**45.26**
HIGH INTRA-ABDOMINAL TESTIS	**14**	**14.74**
EXTRA-ABDOMINAL TESTICULAR NUBBIN	**17**	**17.89**
PEEPING TESTIS	**7**	**7.36**
VANISHING TESTIS	**5**	**5.26**
INGUINAL TESTIS	**5**	**5.26**
INTRA-ABDOMINAL TESTICULAR NUBBIN	**2**	**2.11**
PMDS	**2**	**2.11**
TOTAL	**95**	**100**

TESTICULAR LOCATION AND STATUS



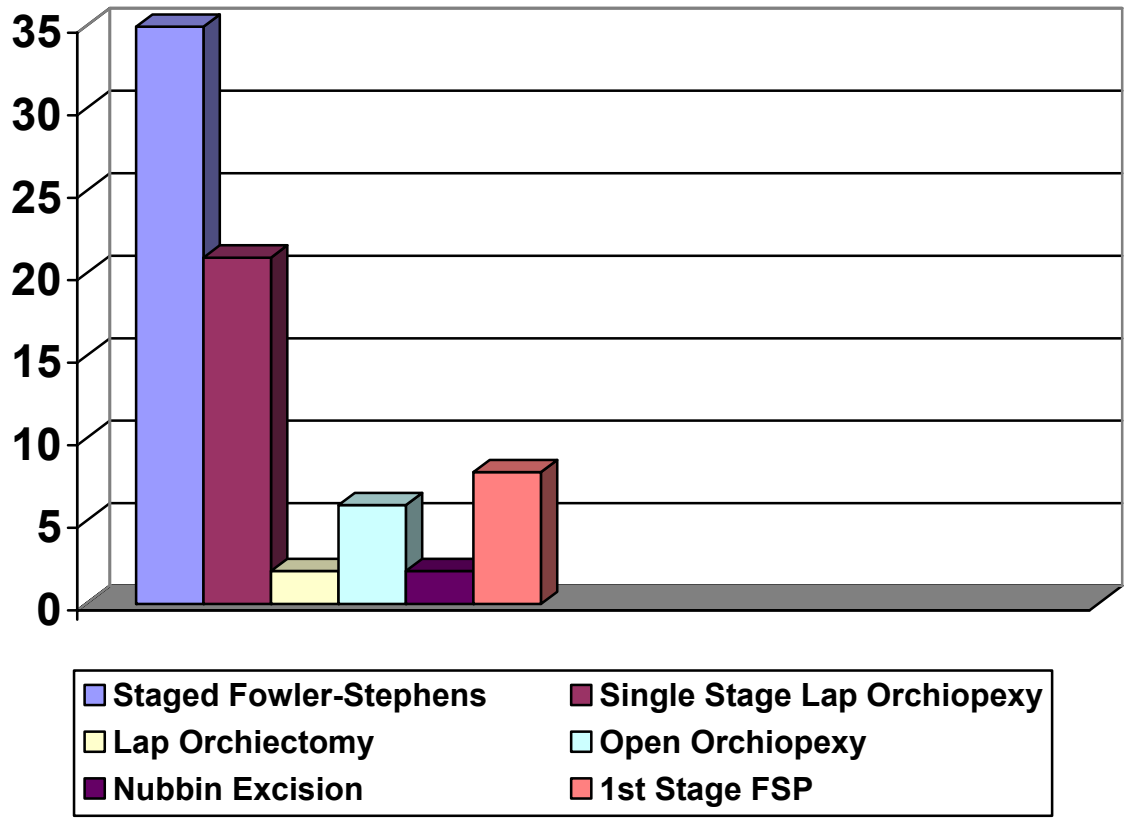
Diagnostic laparoscopy was confirmatory in 77.1% of testicular units under study, in that, an intra-abdominal testis, or an intra-abdominal nubbin, or a vanishing testis, or persistent mullerian duct syndrome was positively identified. In the remaining 22.09% of testicular units the probability of the testis having emerged out of the abdominal cavity was confirmed. In these cases the status of the testicular artery and the vas was suggestive of the likely condition of the dependant testis, with the exception of two cases of testicular

atrophy where normal appearing vessels entering the deep ring led us to explore the groin.

OPERATIVE PROCEDURES

OPERATIVE PROCEDURE	NO OF TESTICULAR UNITS	%
Staged Fowler-Stephens Procedure	**35**	**47.39**
Laparoscopic Single Staged Orchiopexy	**21**	**28.30**
Laparoscopic Orchiectomy	**2**	**2.70**
Open Orchiopexy	**6**	**8.10**
Atrophic testis Excision	**2**	**2.70**
1st Stage Orchiopexy	**8**	**10.81**
TOTAL	**74**	**100**

OPERATIVE PROCEDURES UNDERTAKEN



The diagnostic evaluation and operative management was completed with laparoscopy alone in 58 patients, two of whom underwent laparoscopic excision of the intra-abdominal nubbin.

Six patients with missed canalicular testis needed inguinal exploration and open orchiopexy, and, in these cases laparoscopy was used for

a) intra-abdominal vascular mobilization

b) to ensure under vision that there was no undue tension on the vessels

c) to rule out any twist on the vessel compromising vascularity of the testis

Two cases underwent inguinal exploration and nubbin excision as vessels entering the deep ring appeared to be of good caliber.

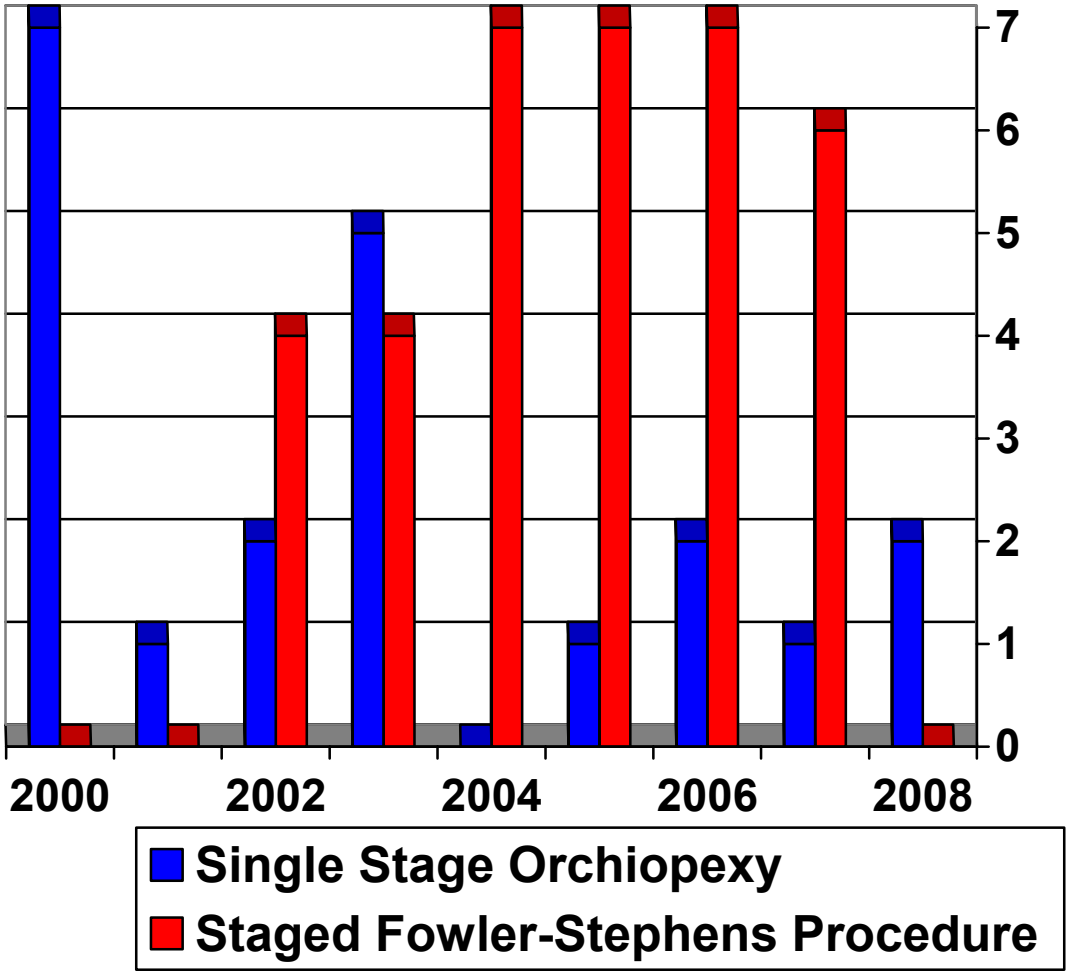
The one child with PMDS underwent laparoscopic biopsy initially. After the gonadal biopsy specimen showed normal testicular tissue, laparotomy division of the mullerian structures in the midline and left sided testicular vascular ligation and division and right open orchiopexy was done. Subsequently the second stage of the Fowler-Stephens orchiopexy was done laparoscopically. None of our patients underwent a single staged laparoscopic Fowler-Stephens procedure

A very distressing fact was that 4 patients accounting for 5 testicular units have been lost to follow-up subsequent to the 1st stage of the Fowler-Stephen vascular ligation. Three patients are still awaiting the second stage of the staged procedure, ie., it has been less than a year since the 1st stage of the Fowler-Stephens procedure.

TREND OF PROCEDURE SELECTION OVER THE YEARS

YEAR	SINGLE STAGE ORCHIOPEXY	STAGED FOWLER-STEPHENS PROCEDURE
2000	7	NIL
2001	1	NIL
2002	2	4
2003	5	4
2004	NIL	7
2005	1	7
2006	2	7
2007	1	6
2008	2	NIL
TOTAL	21	35

TREND OF PROCEDURE SELECTION OVER THE YEARS

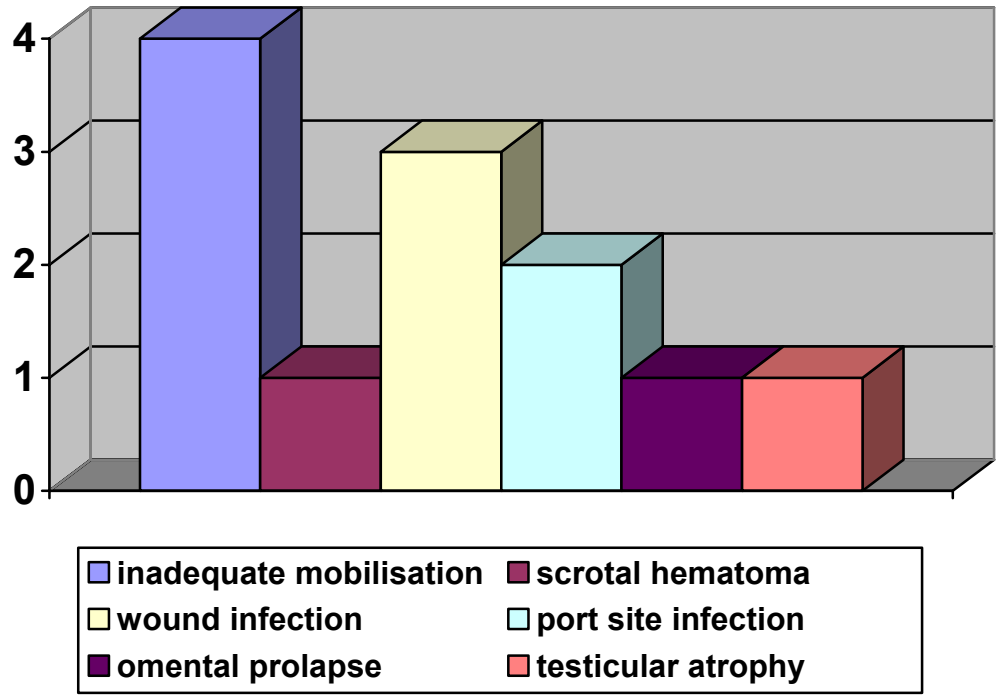


When we began our departmental foray into laparoscopic orchiopexy we initially opted for the single staged mobilization of vessels and orchiopexy, but, two instances of unsatisfactory mobilization and testicular atrophy at follow-up prompted an operator bias towards the more conservative staged Fowler-Stephens orchiopexy. This line of thought did not stop us from doing single stage orchiopexies in those cases in whom preoperative findings warranted such course.

EARLY COMPLICATIONS

COMPLICATION	NUMBER
INADEQUATE MOBILISATION	**4**
SCROTAL HEMATOMA	**1**
WOUND INFECTION	**3**
PORTSITE INFECTION	**2**
OMENTALPROLAPSE	**1**
TESTICULAR ATROPHY	**1**
TOTAL	**12**

EARLY COMPLICATIONS



Early complications were noted in 13.15% of the cases. Successful scrotal mobilization of the testis could be achieved in fifty-nine of the sixty-three testicular units that required mobilization. Of the 4 units with inadequate mobilization two were older children (12 and 10 years old) who underwent single stage orchiopexy for a low intra-abdominal testis and the other two testicular units were in a case of bilateral high intra-abdominal testis in a seven year old child who underwent staged Fowler-Stephens procedure. Laparoscopy specific complications were noted only in 3cases, and these were minor in the form of 2 cases of port site infection and 1 case of omental prolapse through the umbilical port site. In one case significant loss of

testicular volume was noted at the time of the second stage of the Fowler-Stephens procedure.

EARLY FOLLOW-UP

Outcome	Staged Fowler-Stephens(%)	Single stage orchiopexy (%)	Open orchiopexy(%)
Good volume, low scrotal testis	**18(52)**	**7(33)**	**1(17)**
Good volume, high scrotal testis	**2(5)**	**3(14)**	
Poor volume, low scrotal testis	**4(11)**	**2(10)**	**1(17)**
Poor volume, high scrotal testis	**2(5)**		
Testicular atrophy	**3(8)**	**3(14)**	**2(34)**
Not due	**2(5)**	**3(14)**	
Lost to follow up	**4(11)**	**1(5)**	**2(34)**

At follow-up ranging from 1year to eight years 64.6 percent of the scrotalised testicular units that were available for evaluation were

found to have good volume. Around sixty-seven percent (66.75%) of case were found to lie low within the scrotum. Testicular atrophy was noted in 16.69 % of the testicular units. Eight percent of the cases are not yet due for follow-up.

Comparing the outcome among the cases that underwent staged orchiopexy and single-stage orchiopexy 65 % as against 67% showed good volume, 71% as against 60% showed a low scrotal position and 10% as against 20% were noted to have testicular atrophy respectively. Seven testicular units that were scrotalised were lost to follow-up. Testicular evaluation was not relevant for those cases that had absent or atrophic testis at the preliminary setting. Among them, those children that had bilateral testicular atrophy and have reached the pubertal age group are being followed up for the necessary hormonal replacement therapy. Five testicular units have not been subjected to second stage orchiopexy as they have been lost to follow up.

REVIEW OF LITERATURE

Laparoscopic diagnosis has been applied in pediatric urology for more than 30 years. The initial report was from Cortesi et al[1], in 1976 regarding the use of laparoscopic techniques to identify cryptorchidism. Again, the clipping of the testicular vessel for a first-stage Fowler-Stephens operation heralded the onset therapeutic pediatric laparoscopy in the year 1991 by Bloom[2]. This was followed by laparoscopic orchiopexy by Jordan and Winslow in the year 1992. From such an auspicious beginning it is only natural that today one of the widest applications of pediatric laparoscopy is in the diagnosis and management of cryptorchidism.

Truly impalpable testes are relatively rare accounting for roughly 20% of all undescended testes (range 5-28%)[3,4]. Of these, upto 25% can be canalicular, 45% are intra-abdominal, and the rest may be absent. Absence is termed as a vanishing testis and is a consequence of intrauterine torsion of the spermatic cord during migration of the gubernaculum to the scrotum leading to secondary atrophy of the testis. Such cases are usually associated with compensatory enlargement of the contralateral descended testis[5,6], though it is not a reliable criterion for making a diagnosis[7] .

Numerous investigative modalities have been used to identify the presence and location of the non-palpable testis[7]. In addition to describing an identified testicle, it is essential that any diagnostic modality should be able to state with 100% accuracy, the absence of an intra-abdominal testis, to obviate the consequences of a retained unrecognized intra-abdominal testis. Pneumoperitoneography utilizing nitrous oxide[8], contrast peritoneography, aortography[9], selective angiography and spermatic venography are some of the invasive diagnostic techniques[10-13] that have been attempted. Their routine use is limited by the innate invasiveness, requirement of anaesthesia, technical difficulty to perform or the significant rate of false-negative results. Any such invasive techniques are now reserved only for planning the rare case of autotransplantation. Imaging modalities including inguinal ultrasonography[14], computed tomography[15] and magnetic resonance[16] imaging have a definite role in identifying the clinically impalpable or missed inguinal testis but the overall accuracy in identifying an impalpable testis is limited[17] at around 44%[7] In literature, short series are available reporting a 96-100% success rates in identifying the presence and site of the impalpable testis, even if it is just a nubbin, using gadolinium–infusion magnetic resonance angiography. Though the results are

encouraging, the numbers are small, and, the cost and availability of the particular tool are limitations in the present scenario.

In contrast, numerous studies have identified the efficiency of diagnostic laparoscopy in nonpalpable testis[18,19,20]. The safety of laparoscopy has been well established. Diagnostic laparoscopy in undescended testis has a long record of experience with consistent results. The primary aims of diagnostic laparoscopy are to identify the presence or absence, the location, and the anatomy of the nonpalpable testis. It is important to first confirm impalpability even under anaesthesia, thereby avoiding an unnecessary laparoscopy in a reported 18% of cases[21], ultimately enhancing the specificity of laparoscopy.

DIAGNOSTIC LAPAROSCOPY

The Veress needle or the blind or visually aided trocar access technique or the open technique is used to access the abdominal cavity. The camera is introduced through the infra- or supraumbilical port. Newer techniques include the use of minilap or needlescopic technique. The bladder should be emptied and ideally remain catheterized throughout the procedure.

Examination of the normal side should be performed first to provide an image of the normal anatomic arrangements in the

individual patients. The triangular arrangements of the medial vas deferens, lateral spermatic vessels and iliac vessels provides a basis for contralateral comparison. The obliterated umbilical artery is usually the most readily recognized structure in the area of the internal ring. The vas deferens crosses over it from the medial to lateral side and courses toward the internal inguinal ring. The vas is then joined by the testicular vessels, which can be traced cephalad, running parallel to the iliac vessels. The testicular vessels usually form a very distinct bundle of vessels, and their appearance should be taken note of because it can indicate the status of the testis. The internal inguinal ring is usually closed and appears as a flat area of the peritoneum with the vas deferens and the vessels passing through it. A patent processus processus vaginalis may be present, and this is often, but not always, associated with the presence of a testicle. This may be considered as an indication that a testis is present within the canal, but it is not an infallible finding, and applied practically it is not as significant to management as the information provided by the appearance of the vas deferens and the vessels [22].On the affected side there are three basic patterns that may be seen.

a) Vas and vessels dwindle away before the internal inguinal ring. This blind ending vessel is the sine-qua-non of a vanishing intra-abdominal testis and in this instance there is no reason to explore the inguinal ring as it will be empty.

Figure 14 **Blind ending vas and vessels**

Often, though a vas-like structure is seen the vessels are not readily seen. In such cases, a careful and thorough examination going right up to the aorta is warranted to identify the vessel as it may act as a guide to an almost normal testicular structure that is totally dissociated from the vas. Occasionally, this may imply a need to move the left colon or the cecum out of the way or formally mobilize

the bowel, warranting the use of an additional port. Testes have been identified just below the kidney and even near the rectum within the pelvis using this technique.

b) The vas and the vessels may be seen to enter the internal ring appearing very similar to the normal situation.

Figure 15 Vas and vessels entering deep ring

This mandates careful assessment of the caliber of the vascular bundle. If the vessels are robust and thick and comparable to the

opposite a testis is likely to be present. If they are thin and delicate appearing it is most likely that an atrophic testis will be found within the inguinal canal or the scrotum, though there is the odd exception.

c) An intra-abdominal testis may be readily visualized.

Figure 16 Low Intra-Abdominal Testis

It maybe a ‘peeping’ testis that only just moves into the inguinal canal and back into the abdomen. It is always associated with a patent processus vaginalis. Alternatively the testis may be located in

any number intra-abdominal positions. The most common positions are along the normal anatomic course of the testicular vessels up to the level of the kidney.

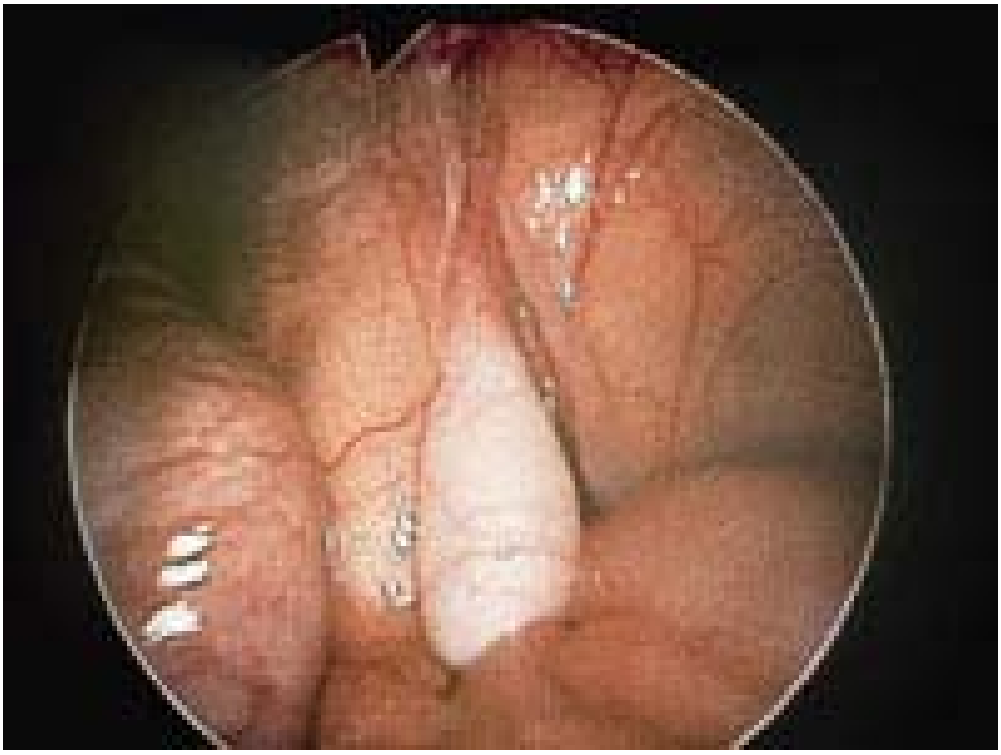


Figure 17 High Intra-abdominal Testis

Variously the testis has been found along the medial aspect of the iliac vessels and even so far inferior as to be adjacent to the bladder or even the rectum. There have been reports of the intra-abdominal testis being found in totally bizarre position including adjacent to the liver as well as passing through the obturator foramen. When the anatomy is not clear it is always wise to assume that the testis is in an unusual position and trace the testicular

vessels to their termination very meticulously. This nullifies the chances of missing an intra-abdominal testis.

A meta-analytic review of published series of diagnostic laparoscopy for nonpalpable testis up to 1996[22] accounting for a total of 1311 patients revealed the findings as shown in the following tabular column

Finding	Number	Frequency
Intra-abdominal testis	**486**	**37%**
Transinguinal testis	**14**	**1%**
Vas & vessels through ring: testicular nubbin	**381**	**29%**
Vas &vessels through ring: testis present	**188**	**29%**
Intra-abdominal vanishing testis	**213**	**16%**
Nondiagnostic	**29**	**3%**

There is lack of universal agreement as to the utility of diagnostic laparoscopy, the principal challenge being that it does not

significant information that alters clinical management to justify the risk and time involved. One randomized clinical trial examined this problem comparing diagnostic laparoscopy and inguinal exploration[23] and the authors concluded that laparoscopy did not provide any reduction in time or improvement in outcomes. But these authors did not attempt operative laparoscopy in the event that an intra-abdominal testis was identified. Another disadvantage claimed by the authors was that regional anaesthesia alone would not suffice if laparoscopy was included. The integration of operative laparoscopy with diagnostic laparoscopy affords an additional benefit because there is a rapid transition to laparoscopic orchiopexy after the diagnosis is made, and this is the next major advantage in favour of laparoscopy as a management tool. Proponents of inguinal exploration as against diagnostic laparoscopy[24] claim that the presence of a hernial sac is associated with a testis in all cases and should lead to abdominal exploration obviating the need for a laparoscopy. But on numerous instances intra-abdominal testis with a closed off internal ring and no hernial sac has been identified. The inference being that the presence of a hernial sac is always associated with an undescended testis, but absence of a hernial sac does not rule out the presence of a testis in which case the inguinal

exploration will be inconclusive. To some schools of thought an unnecessary or unproductive inguinal exploration is less morbid procedure than an unfruitful laparoscopic exercise[25,26]. Further strengthening the case for diagnostic laparoscopy are several reports of testes deemed to be absent on groin exploration being found laparoscopically in 39-93% of cases [27,28,29,30]. Even though these missed testes might be attributed to limited experience of the initial operator it only points to the fact that open exploration is not particularly straightforward. It is difficult to prove or disprove this contentious issue in a quantitative manner. In conclusion laparoscopy provides specific information regarding the location and the character of the testis to permit an informed decision regarding the best surgical approach. And this information has led to a change in surgical therapy in 50-60% of patients[21].

Once the findings are documented further course of action is readily charted. In the event of identification of an intra-abdominal vanishing testis, no further intervention is needed and the procedure is concluded with no additional incision. If the testis is very atrophic and it has minimal structural attachment the better option may be to go ahead with an orchiectomy

If the vas and vessels are atretic and pass through the internal inguinal ring, it can be presumed that a vanishing testis is present and a small, low inguinal exploration is performed at the level of the pubic tubercle. This permits confirmation of the diagnosis with excision of a nubbin of testis, which can be subjected to routine histopathology.

In the unusual case where the vas and vessels entering the internal inguinal ring are found to be healthy and similar in dimension to the normal contralateral side a formal inguinal incision is used to explore and identify the testis that could not be palpated under anaesthesia.

The identification of an intra-abdominal testis opens up the situation where diagnostic laparoscopy exhibits its next major advantage over all other imaging investigative modalities. While any imaging technique after identifying the testis needs to be paired with an additional surgical procedure laparoscopy is utilized for definitive treatment as well.

PRIMARY SINGLE-STAGE LAPAROSCOPIC ORCHIOPEXY

The decision to proceed with laparoscopic intervention having been made the choice of procedure depends on the site of the testis

in relation to the deep ring. In the majority of cases the testis will be found within 1cm of the internal ring. Peeping testis can be pushed into the abdominal cavity by applying pressure on the inguinal canal externally

If the choice of procedure is a primary single stage laparoscopic orchiopexy, additional working ports are introduced under direct vision. These are sited bilaterally at the level of the umbilicus along the mid clavicular line, taking care to avoid underlying vessels particularly the epigastric vessels. It may be necessary to introduce the ports at a higher level in younger children to enhance the operative space. Two grasping forceps are introduced to apply traction on the gubernaculums in order to bring as much of it as possible into the abdominal cavity. At this juncture it essential to take meticulous care to avoid injuring the occasional long looping vas, as well as at the time of transection of the gubernaculum. Ideally the gubernaculums is minimally cauterized and cut to achieve hemostasis and at the same time prevent dissipation of heat to the closely related vas. The dissection is carried medially over the bladder, incising the peritoneum distal to the vas and extending towards the contralateral medial umbilical ligament. The intention is to maintain a generous segment of peritoneum between the cut edge

and the vas. The dissection is carried lateral to the testicular vessels to the colon. The peritoneum is then incised medially over the proximal spermatic vessels. This is a critical step to provide adequate mobilization. As a consequence a generous triangle of undisturbed peritoneum is spared between the vas and the vessels. This has the theoretical advantage of preserving collateral vascularity between the vas and the spermatic vessels in case vascular transection is deemed necessary later. There is also the practical advantage of allowing a Fowler-Stephens approach if it is found that the vessels are still inadequate in a length at the end of the dissection. A careful lateral dissection of the Denis-Browne ligaments further enhances testicular mobilization.

When the testicular vessels have been adequately dissected the testis should easily reach the opposite internal inguinal ring. This sign of adequate length is more appropriately applicable in the younger child. In older and larger children more generous mobilization should be achieved.

A neo-inguinal canal starting medial to the medial umbilical ligament and lateral to the bladder and hugging the pubic tubercle and emerging through the external inguinal ring is created in order to offer the shortest route for the testis to the scrotum – a gain of 5-10

mm. First, a hemi-scrotal incision is made either vertically or horizontally as per preference and a sub-dartos pouch is created. The canal can be created in an ante grade fashion using a laparoscopic dissector to enter the scrotum and emerge through the previously made hemi-scrotal incision, or, it can be fashioned in a retrograde fashion by making a hemi-scrotal incision and creating the canal taking care to guide the instrument along the pubic tubercle and using laparoscopic visual guidance to enter the abdominal cavity. The neo-channel is dilated up to 5 or 10 mm as warranted by the volume of the testis. A guiding instrument is introduced through an adequate sized laparoscopic port, through the scrotum, and ideally the gubernaculum is grasped and gentle steady traction is applied to deliver the testis into scrotal wound. Orchiopexy is performed by fixing the testis in the preformed pouch and closing the skin.

LAPAROSCOPIC TWO-STAGE FOWLER-STEPHENS ORCHIOPEXY

Orchiopexy can sometimes be performed only by dividing short testicular vessels. This is especially true older children. This two-stage procedure is mandated when the testis is too far from the internal ring and it seems unlikely that a primary laparoscopic

orchiopexy can be performed. This procedure was first described by Bevin inn 1903[33]. It was popularized only in 1959 when Fowler and Stephens better characterized the blood supply of the testis[31] demonstrating constant and reliable collaterals to the testicular artery from the vasal and the cremasteric arteries before it reaches the testis. They contended that ligation very close to the testis would compromise collateral blood supply and lead to testicular atrophy they also recommended test clamping of the testicular artery to confirm adequacy of the collateral blood supply. Johnston[32] advocated leaving a broad medial strip of peritoneum to further preserve collateral blood supply

Jarow[33] has undertaken studies of vascular anatomy to show that large caliber anastomotic channels exist between the testicular and vasal arteries, that typically run beneath the tunica albuginea and communicate with the inferior pole of the testis. Koff suggests that high ligation of the testicular artery may in fact contribute testicular ischaemia by limiting the dissection between the ascending and the descending vassal loops to unfold the testis. He also proposes that additional collateral blood supply can be derived from distal testicular vessels that are left intact. On the basis of this rationale he proposes a modification of the Fowler-Stephens procedure by way of ligating

the vessels as close to the testis as possible. Several authors have emphasized the need for gubernacular preservation[34].

When a division of the testicular vessels is warranted it is definitely advantageous to do it in a staged manner[22], as opposed to a single staged procedure. In the first stage, at the time of diagnostic laparoscopy, the vessels are divided. Various techniques can be used, including clip application and division, cauterization and division, and also laser vessel ablation.

Open or laparoscopic orchiopexy is performed as a second stage of the procedure after a period of six months after the initial clipping. Port placement is similar to what was followed at the primary laparoscopy. Repeat laparoscopy is usually uneventful. There maybe minimal adhesion formation as a result of the initial intervention. Occasionally the testis is found to be atrophic as a consequence of the primary vascular clipping, and this possibility should be discussed with patient's family before the initial laparoscopic exploration.

The area around the previous vascular clipping is identified and dissected allowing the testis to be retracted to facilitate the remainder of the dissection and mobilization .the peritoneum is incised lateral to the distal vessels and testis and distal to the vas deferens. The gubernaculums is isolated and divided as described in

primary laparoscopic orchiopexy. Invariably with this maneuver adequacy of length is never a problem. The delivery of the testis and fixation in the sub-dartos pouch are done as previously described. If testicular positioning is unsatisfactory further lateral dissection can be done while holding the testis in the scrotum. The possibility of developing a hernia at the internal inguinal ring and along the inguinal canal is remote, therefore, there is no necessity to actively attempt to close the internal ring after orchiopexy, the only reported instance being deemed to be of only anecdotal significance.

RISKS AND COMPLICATIONS

As in open orchiopexy laparoscopic orchiopexy also runs the risk of

a) Bleeding
b) Hematoma formation
c) Ilioinguinal nerve injury
d) Vassal injury
e) Post-operative testicular torsion
f) Infection
g) Testicular atrophy
h) Testicular malposition or retraction

i) Recurrence of inguinal hernia

j) Ureteral obstruction due to undue tension on the vas

Likely vascular injuries include

a) Injury to the iliac vessels

b) Avulsion of testicular vessels

c) Inadvertent Fowler-Stephens procedure during delivery of testis into scrotum

d) Injury to the femoral vessels during development of the neo-inguinal canal

In addition complications related exclusively to laparoscopy can be categorized as

a) Anesthesia related complications

b) Injury due to induction of pneumoperitoneum

c) Injury due to trocar placement

d) Injury due to cautery

e) Injury to the bladder

OUTCOMES OF LAPAROSCOPIC ORCHIOPEXY

Conventional orchiopexy for the peeping testis has a satisfactory scrotal placement rate of 82% and for the intra-abdominal testis a rate of 74%[35]. Hazebroek et al kk[36] had an atrophy rate of 16% for open orchiopexy for peeping or intra-abdominal testis on long term follow-up. When vessel transection was warranted atrophy rates were as high as 33%. In contrast, Samadi et al showed a satisfactory scrotal placement rate of 97% using laparoscopic orchiopexy. The staged Fowler-Stephens orchiopexy was found to be a better alternative to one-stage vessel transaction, allowing collateral blood supply to mature and support testicular transplantation more readily. In 1995 Docimo[35] published a review of available literature to show that there was no statistically significant difference between the one stage and two stage vessel trisection when performed by the open technique with success rates of 68.5%(76 out of 11) for the single stage procedure and 76.8%(43 out of 56) for the staged procedure

Another concern has been the cost factor involved in laparoscopy. Lorenzo et al[37] reported on a computer based analysis of costs of surgery for non-palpable testis and did not find any statistically

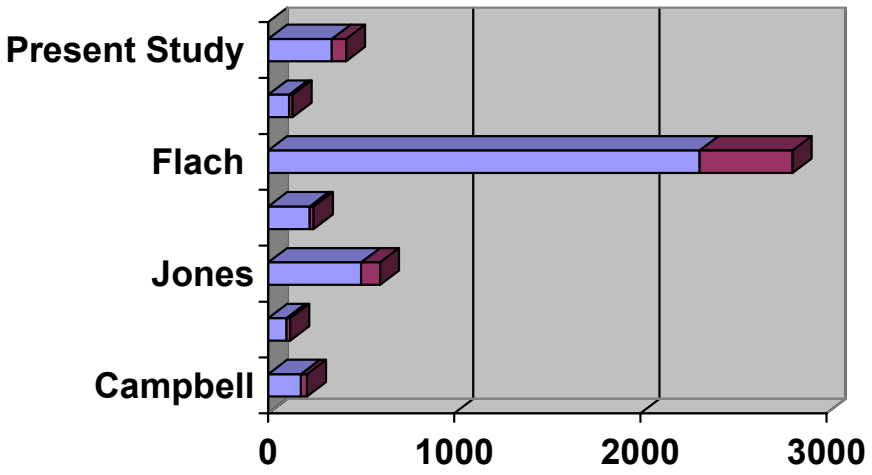
significant difference between open and laparoscopic procedures. The cost of laparoscopy can only be expected to further decline in future.

DISCUSSION

Incidence

The incidence of impalpability of the undescended testis compared to palpable UDT has been documented to vary between 9 and 21.5 %. The incidence documented in our study compares very favorably.

		Impalpable testis	
Study	**No of patients**	**n**	**%**
CAMPBELL	**176**	**33**	**19**
TIBBS	**99**	**19**	**19**
JONES	**500**	**102**	**21**
SCORER AND FARRINGTON	**224**	**21**	**9**
FLACH	**2319**	**499**	**21.5**
ILLIG ET AL	**112**	**20**	**18**
PRESENT STUDY	**343**	**76**	**22.15**



Among our children 18 were monorchid and three were anorchid accounting for about twenty-eight percent of the cases. This is marginally less than the 33-45% reported in literature, but still comparable

Laterality

In our study out of the cases with unilateral crypytorchidism there was a slight preponderance towards the left side representing 55.77%. World literature has regularly documented the right side to be twice as frequently affected as the left side

Contralateral testicular hypertrophy

In our study one child who had a testicular volume of >2cm, suggesting contralateral hypertrophy had a normal low intra-

abdominal testis. All other children with contralateral hypertrophy had ipsilateral atrophy.

Findings on diagnostic laparoscopy

Comparing with the meta-analytic review of all published series up to 1996 by Cisek et al[21] in our series the order of frequency of the various findings was similar but the actual frequencies were quite variable as shown in the table below.

Findings	Meta-analysis	Present study
Intraabdominal testis	486(37%)	57(60%)
Transinguinal testis	14(1%)	7(7.5%)
Testicular nubbin	381(29%)	17(18%)
Inguinal testis	188(14%)	5(5.5%)
Vanishing testis	213(16%)	7(7.5%)

Surprisingly despite our minimal reliance on preoperative diagnostic imaging we had a much lower incidence of the missed inguinal testis, representing only a third of the frequency reported by the meta-analysis.

Operative procedure

The use of laparoscopy gives unparalleled magnification and a wide field of vision permitting careful and precise dissection. The extensive inguinal and flank incision dissection and consequent post-operative morbidity of an open procedure is avoided. The use of laparoscopy obviates the need for extensive and painful inguinal exploration in cases of testicular atrophy.

Careful preoperative attention to detail assessing the position of the testis and the length as well as the laxity of the vessels is essential to make an informed decision regarding the type of procedure to be undertaken and this in turn determines the outcome of the procedure.

Complications

Thirteen percent of our patients had complicatios of surgery. Of these 25% were specific to laparoscopy and they were minor complications in the form of port site infection and omental prolapse. We did not have any cases of bladder injury. In 4 testicular units we were able to mobilize the testis only to the root of the scrotum. Two units were high intra-abdominal testes that were subjected to staged Fowler-Stephens'. The other 2 patients underwent a single stage

orchiopexy. One patient had a significant loss of volume after the first stage of orchiopexy.

Operative outcome

In our series we were able to report 31(63.27%) of cases with low scrotal testis and, 30(61.22%) of cases with good testicular volume and atrophy was seen in 6(12.24%) of the 49 cases of intra-abdominal testis that were managed laparoscopically.

Snodgrass et al[38] presented a series of 42 cases of low intra-abdominal testis managed laparoscopically that were available for follow up at a mean of 6.8 years. They found 25 (60%) of low scrotal testis, and 14% atrophic testis with 12% requiring re-operation for testicular malposition.

Several other authors have made a strong case for laparoscopic management of the impalpable UDT. Abolysr[39] reported on 44 testicular units at a mean follow up of 6 months. He showed 93% with acceptable scrotal position and no cases of atrophy. Lindgren BW et al[40] have reported on 39 testes after randomization to laparoscopy, with two cases of atrophy and less morbidity compared to the open orchiopexy arm which had 3 cases of atrophy.

CONCLUSIONS

1. The relative incidence of testicular impalpability in UDT is 22.15%.
2. Diagnostic laparoscopy positively identifies intra-abdominal testicular location or atrophy in all cases.
3. The status of the testes that had emerged was correctly indicated in most cases.
4. Laparoscopy was an effective tool in almost 95% of cases for either diagnosis or mobilization,and would have been unnecessary in only about 5% if an ultrasonogram had been done preoperatively.
5. Laparoscopy is safe and effective and well tolerated.
6. The results of the single-staged and the staged Fowler-Stephen procedure are comparable when intra-operative findings are analyzed before decision making.
7. The delayed presentation of cases is a cause for concern.
8. Long term follow up is needed for final evaluation.

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PROFORMA

Sl No IP No

Name- Age-

Presentation-

□ Bilateral □ Unilateral □Right □Left

h/o Torsion h/o Trauma

Associated hernia

Scrotum

Palpable Testicular size

Associated findings

USG

Diagnostic laparoscopic findings

□ Single stage □ Two stage

Operative details

Single stage

Post operative period

Stage I

Post operative period

Stage II

Post operative period

Follow- up

S	Name	Age	IP No	Presentation	Associated finding	Finding	Procedure	Post-op	Follow-up
1	Kalidas	12y	22645	Rt UDT		Rt peeping testis	Single stage Orchiopexy	Bleeding	Lost to f/u
2	Naveen Kumar	1y	21141	Lt UDT		Lt low IAT	Single stage Orchiopexy		Good vol high
3	Darmaraj	10y	31943	B/LUDT		B/L low IAT	B/L single stage Orchiopexy		Low Lt atrophy
4	Govindaraj	8	43091	Rt UDT		Rt peeping testis	Single stage Orchiopexy	Omental prolapse	Rt hypoplastic
5	Karthikeyan	2y	51146	B/L UDT	Prune belly	B/L low IAT	Single stage Orchiopexy		Good vol Low
6	Gokulraj	12y	53320	Lt UDT		LT canalicular testis	Lap mob& open pexy		Lost to f/u
7	Kathiravan	6y	56919	Rt UDT		Rt IAT – atrophic	orchiectomy	Port site inf	-
8	Samsuddin	3y	142	Lt UDT		Extra-abdominal nubbin	-		-
9	Gowtham	12y	24531	Lt UDT		Extra-abdominal nubbin	-		-
10	Rajkumar	6y	24911	Rt UDT		Rt inguinal nubbin	Nubbin excision		-

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11	Mohan	1y	27685	Lt UDT		Lt inguinal nubbin	-		-
12	Ramesh	10	53267	Lt palpable Rt impalpable	B/l cong cataract, chest deformity	Rt low IAT	Rt Single stage Orchiopexy Lt open pexy	Inadequate mobilisation	Rt atrophic scrotal
13	Naveen kumar	6y	56281	Lt UDT		Extra-abdominal nubbin	-		-
14	Kathirvelmani	1y	9890	B/l UDT	Phimosis	B/l low IAT	Staged FSP		Good vol low
15	Balakrishnan	9y	34750	Rt UDT		Rt high IAT	Staged FSP		Good vol Low
16	Jakkir Hussain	7y	38367	B/l UDT		B/l scrotal nubbin	Inguinal exploration		On HRT
17	Santosh kumar	10	42933	Lt UDT		Vanishing testis			-
18	Muthukrishnan	10	47151	Lt UDT		Extra-abdominal nubbin	-		-
19	Nagaraj	12	54862	B/l UDT		Extra-abdominal nubbin	-		-
20	Balasubramani	12	67756	Rt UDT		Rt low IAT	Rt Single stage Orchiopexy	Wd inf Inadequate mob	Good vol high

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21	Balamurugan	2y 6m	68445	B/l UDT	Bifid scrotum	Rt high IAT Lt canalicular	Staged FSP		Lost to f/u
22	Navaneethan	6y	5166	Rt UDT		Rt canalicular nubbin	-		-
23	Viswanathan	2y	7394	B/l UDT	Prune belly D hypospad	Rt peeping lt vanishing testis	Single stage orchiopexy	Port site inf	Good vol Low
24	Stephenraj	8y	18790	Rt UDT		Peeping testis	Single stage orchiopexy		Good vol high
25	Prasad	3y	20328	Lt UDT		Low IAT	Single stage orchiopexy		Lt Poor vol, low
26	Naveen Kumar	7y	27207	B/l UDT		B/l low IAT	B/l staged FSP		Good vol Low
27	Prabhakaran	9y	35959	B/l UDT		Rt canalicular, Lt low IAT	Lt 1st stage FSP		Lost to f/u
28	Sriram	1y	36945	B/l UDT Lt inguinal		Rt low IAT	Single staged orchiopexy		Atrophy
29	Gokul	4y	39354	Lt UDT		Lt cnalicular atrophic	Open orchiopexy		hypoplastic
30	Varadaraj	6y	45823	B/l UDT	Mental retardation	B/l low IAT	Staged FSP	Wound infection	Good vol Low

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31	Arivazhagan	8y	17614	Lt UDT		Peeping testis	Staged FSP		Good vol Low
32	Gokulakrishnan	5y	22528	Lt UDT		Vanishing testis			-
33	Md ASif	8y	23784	Rt UDT		Low IAT	Staged FSP		Good vol Low
34	Harikrishna	2y	42686	Lt UDT		Low IAT	Staged FSP		Lost to f/u
35	Surya	5y	38963	B/l UDT		Lt Low IAT Rt canalicular	Lt Staged FSP Rt open pexy	Lt hypoplasi	Lt high, lt < rt
36	Parthiban	6y	42694	Lt UDT		Peeping hypoplastic	Single stage orchiopexy		Good vol Low
37	Gowtham	4y 6m	52597	Rt UDT		Peeping testis	Staged FSP		Good vol Low
38	Karthik	1y	25621	Lt UDT		Low IAT	Staged FSP		Low lt < rt
39	Suresh	4y	64657	Rt UDT		Low IAT	Staged FSP		Good vol Low
40	Ajay	6y	23190	Rt UDT		Low IAT	Staged FSP		Good vol Low

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41	Arunraj	9y	25317	Lt UDT	Panhypopituitarism	Low IAT	Staged FSP		Lt < rt
42	Rajapandi	5y	27892	Lt UDT		Low IAT	Staged FSP	Bleeding	Lt atrophy
43	Mohankumar	1	31875	Lt UDT		Low IAT	Staged FSP		Lt < rt
44	Saran Kumar	2y	39465	B/l UDT		Extra-abdominal nubbin	-		-
45	Boopathy	1	43764	B/l UDT		PMDS	Conversion		Lt atrophy
46	Boopathy Raja	6	47135	Lt UDT		Low IAT	Staged FSP		Lt = rt
47	Gokul	3y	3021	Rt UDT		Low IAT	Staged FSP		Lt = rt
48	Revan Kumar	3y	4993	B/l UDT		B/l low IAT	Single stage orchiopexy		Good vol Low
49	Dinesh	8y	6298	Rt UDT		Rt high IAT	1st stage FSP		Lost to f/u
50	Balasridar	2y	23453	Rt UDT		Rt high LAT	Staged FSP		Rt < lt

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51	Veereshwar	6y	26955	Lt UDT		IA nubbin	Orchiectomy		-
52	Sudakar	Iy	32422	Lt UDT		Lt canalicular nubbin	-	Wound inf ect	-
53	Manoj kumar	13	2112	Rt UDT		Hypoplastic high IAT	Staged FSP		High rt < lt
54	Manoj Kumar	12	32441	Lt UDT		High IAT	Staged FSP		Good vol Low
55	Shyam	6y	38628	Rt UDT		Low IAT	Staged FSP		Good vol Low
56	Dinesh Kumar	11	40730	B/l UDT Rt palpable		Low IAT	Staged FSP		Lt high atrophic
57	Santosh	6y	41916	B/l UDT		B/l high IAT	Staged FSP	Inadequat mob	Good vol Rt high
58	Devaraj	7y	44657	Lt UDT	Tongue tie	High IAT	1st stage FSP		Lost to f/u
59	Vaishnav	5y	Rt UDT	Rt UDT		Low IAT	Single stage orcchiopexy		Good vol Low
60	Hariharan	5y	3524	Lt UDT		Low IAT	Single stage orcchiopexy		Good vol Low

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61	Rahul	2y	6598	B/l UDT		B/l high IAT	Staged FSP		Low Lt<rt
62	Nagendiran	2y	20818	Rt UDT		Vanishing testis			-
63	Thiyagu	7y	27892	B/l UDT		B/l low IAT	1st stage FSP		Lost to f/u
64	Madan Kumar	7y	41938	B/l UDT		B/l high IAT	Staged FSP	Inadequat mobiln	Good vol b/l high
65	Sanjay	9m	69844	Lt UDT		Extra-abdominal nubbin	-		-
66	Nadash	2y	72330	Rt UDT		High IAT	1st stage FSP		Not due
67	Pramodh	1y 6m	73682	B/l UDT lt palpable		Rt low IAT	Rt 1st stage FSP Lt open pexy		Not due
68	Vasanth Kumar	9y	1022	Lt UDT		Vanishing testis			-
69	Santosh kumar	3y	1039	B/l UDT		B/l low IAT	Staged FSP		Not due
70	Ismail	4y	63954	B/l UDT Rt canalicular		Lt low IAT	Single staged orchiopexy		Not due

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71	Raschid Ahmad	7y	11325	Lt UDT		Peeping testis	Single stage orchiopexy		Not due
72	Stalin	5y	11964	Lt UDT		Lt inguinal nubbin	Nubbin excision		Not due
73	Logashanker	12	11313	Lt UDT		Low IAT	1st stage FSP		Not due
74	Dinesh	4y	15809	Lt UDT		Low IAT	Single stage orchiopexy	Wound inf	Not due
75	Dharmendra	4y	1000	Lt UDT		Low IAT	1st stage FSP		Not due
76	Krishnasamy	9y	21219	Rt UDT		Extra-abdominal nubbin	-		Not due